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IMPROVED VARIETIES OF TIMOTHY.
HARDY ALFALFA.
HARVESTING SOY BEANS.
SOY BEANS FOR SILAGE.

FAT IN MILK OF COWS AT TIME OF
CALVING.
CLEAN CREAM.

JULY, 1912.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.¹

IMPROVED VARIETIES OF TIMOTHY.²

Timothy is the typical hay plant of the United States, and timothy hay has been very generally considered a standard in the comparison of the value of different forage plants. The wide variation in the forage value of timothy grown under different conditions has not been fully realized until within recent years, and therefore little or no attention has been given to its improvement or to the possibility of the development of improved varieties. On this point H. J. Webber, of the New York Cornell Experiment Station, says:

Unlike the majority of our extensively cultivated crops, timothy has not been improved by the segregation of different varieties or races. Almost all our cultivated plants and animals are represented by numerous varieties and breeds. We do not cultivate simply wheat, corn, or apples, but we grow Dawson Golden Chaff wheat, Leaming corn, or Baldwin apples. We have hundreds of different races and varieties of these crops that have been bred and selected because of their superior qualities and fitness or their adaptability to certain soil or climatic conditions. It is well recognized that different varieties of cultivated plants differ in their adaptability to various soils, yet when we buy timothy for planting we buy simply timothy seed, and not any special variety of known origin and value. We know nothing of its special fitness for our farms and climate other than that, in general, timothy does well in our State. If we ask for selected seed, what we get is simply seed that has been specially cleaned and winnowed or is from a particularly well-cured crop. It is clear that such procedure is contrary to the well-known principles of agriculture, and if we desire to secure the best possible crops of hay we must plant improved varieties adapted to our conditions. * * *

It is clear that the most important problem before hay growers to-day is to secure improved varieties that are known to be adapted to local conditions and fitted to give the best quality and yields of hay under these conditions. Not until good varieties adapted to various regions have been secured can we expect any very general improvement and increase in the hay crop * * * of the country.

The Cornell station began the improvement of timothy in 1903.

Previous to the beginning of the Cornell experiments, little work had been undertaken in breeding timothy. Prof. Hays, at the Minnesota Experiment Station, had made some studies of the variations but no improved varieties

¹ A progress record of experimental inquiries published without assumption of responsibility by the department for the correctness of the facts and conclusions reported by the stations.

² Compiled from Minnesota Sta. Bul. 20; New York Cornell Sta. Bul. 313; Proc. Soc. Prom. Agr. Sci., 1895, pp. 29-33; 1911, pp. 71-98.

were introduced. Somewhat later, in 1894, Dr. A. D. Hopkins, of the West Virginia Experiment Station, made selections of a number of different types observed in nature and tested their comparative yielding powers. He obtained several different varieties, which were placed with the United States Department of Agriculture for comparative trial and distribution. These varieties have been under trial by the department for several years but have not been generally distributed. These two attempts, so far as the writer is informed, comprise all the work on breeding timothy that had been undertaken in the United States prior to the beginning of the Cornell experiments.

In beginning the experiments [at the Cornell station], timothy seed was obtained from 163 different places in the United States and 60 places in foreign countries. Over 17,000 individual plants were grown from this seed and



FIG. 1.—Field of timothy plants grown for selection, showing variation in size and form of individual plants.

these have formed the basis for study of variations and selection of improved types. * * *

Aside from increasing the yield it has been found possible to secure other important improvements, such as resistance to rust. Rust is a disease of timothy that does much damage to the crop in New York State. The best of the new varieties are in large measure resistant to rust. It is also important in the timothy industry to have varieties ripening at different seasons, and early, medium, and late sorts have been produced. In ordinary timothy, when the proper stage for cutting is reached, many of the leaves are usually more or less dried out. Green-leaved types have been secured, on which the leaves remain green and fresh until the seeds have matured fully. Hay from such sorts is of superior quality. (See figs. 1-5.)

In the course of the experiments a simple method of breeding has been devised for use in the improvement of timothy. This method is thought to be

easy of application and to be adapted to the general use of farmers and especially of timothy-seed growers. It is described in detail in the bulletin [as follows]:

(1) **Manner of procuring seed for starting a selection.**—When timothy is ripening, go over a field carefully and choose a number of good, ripe seed heads from tall, robust culms, which appear to come from good plants. Also, look for exceptionally good plants along the roadsides and fences, and whenever good plants are found preserve good heads for seed. In this way choose good seed heads from at least 10 or 20 good plants. Thrash the seeds from these heads, keeping separate the seeds from each plant, and sow them immediately.

(2) **Planting the seeds.**—As soon as the seed from the selected heads has been thrashed, take small boxes, about 2 feet long by 1½ feet wide and 4 inches



FIG. 2.—Rows of timothy, each propagated by slips from the original seedling. Each row represents a distinct type.

deep, and fill them with good soil from some location where there has been no timothy and thus where there is little likelihood of timothy seed being in the soil. Pack the soil down in the box slightly and smooth off the top, removing all lumps. Now plant the seed from the different heads in short rows in the boxes, placing the rows about 2 to 2½ inches apart. Be careful to keep the seeds from each head or plant separate from one another and plainly labeled. In planting the seed, open shallow furrows in the soil and sow the seed in the furrows by hand, arranging so that the seed will be covered about one-fourth of an inch deep when the dirt is pushed back in the furrows. Sow the seed rather thickly in the rows, but expect to thin out later so that the plants will stand about 1 inch apart in the rows. Sow enough seed so that when properly thinned there will remain about 50 plants from each of the selected heads.

After the seed is sown (and this should be done as soon as the heads are gathered), water the seed boxes carefully with a fine spray, in order to prevent washing the seed out. A good way is to cover the box with an open-mesh cloth, such as cheesecloth, and sprinkle the water on this cloth until the soil is thoroughly wet. Then place the seed boxes in the shade in a moist place, as on the north side of the house. It is a good practice to keep the boxes covered with paper until the young plants begin to appear, and it is important to keep them well watered at all times. When the young plants are well up, thin them to about 1 inch apart in the rows, leaving the strongest plants.

The plants can be kept in the boxes until about the 15th of September, when they should be planted in the field. About 10 days or 2 weeks before transplanting the plants to the field they should be gradually exposed to the full sunlight and dried out somewhat in order to harden them up.



FIG. 3.—Rows of timothy from inbred seed, showing transmission of type. On right a low plant giving small yield. In center and on left good-yielding upright types.

(3) **Transplanting to the field.**—Choose a place in the field where the plants may remain for at least two years without being disturbed. A good piece of land should be chosen, but not necessarily the best; one should take the ordinary soil of the farm, such as would be used for timothy. Set the plants 2 feet apart in rows that are 4 feet apart. Plant all the seedlings from one head in a row by themselves, so that there is a row for each original selected head. If 10 heads were originally selected and 50 plants are grown from each head, there should be 10 rows 100 feet long, thus occupying a piece of land 40 by 100 feet.

In transplanting the seedlings from the boxes, a time must be chosen shortly after a good rain, when the soil is well moistened. The plants should be set out at some period between the 10th and the 20th of September, if possible, so that they may become well rooted before winter comes on. It may be neces-

sary to hoe them before winter, but this is not likely to be the case if the land is well prepared before the planting.

This plot may be designated as the "seedling test plot."

(4) **Cultivating the seedlings.**—In the early spring the seedlings should be cultivated and hoed, and the cultivation and hoeing must be done thereafter at sufficiently frequent intervals to keep the ground free from weeds and in good condition, as in the case of any other crop, such as corn. These plants will produce a few culms each the following summer, which should be cut early in order that the strength may go into the general growth. Do not attempt to select the best plants the first season. A safe judgment can not be rendered until the second season.

(5) **Selecting the best plants.**—When the plants reach the stage for cutting in the second summer—that is, when they are in full bloom—the final selection of the best individuals can be made. Examine each row critically in order to determine which head or heads have given the best progeny as a whole. If any one or two rows are markedly superior to the others, select several of the best plants in each of these good rows, marking the selected plants by stakes driven down by their sides. * * * Also select the one best plant in each of the other rows and mark these plants by stakes as suggested above.

In making his selections the breeder should decide first whether he desires an early, medium, or late type.

Any perfect plant of these three types, in order to be best suited to the purpose, should necessarily possess the following characters as nearly in the maximum degree exhibited as could be found combined in any existing plant or plants:

- (1) Highest yield.
- (2) A tall plant.
- (3) A broad, thick plant, thus necessarily stooling abundantly.
- (4) With many culms and dense.
- (5) The plant must grow erect, showing no tendency to lodge.
- (6) The plant must have many and large leaves.
- (7) The leaves must extend well to the top of the plant.
- (8) The leaves must remain green until well into the harvesting period or until the heads ripen.
- (9) The plant must be in large degree resistant to rust.
- (10) The heads should be of medium size and should develop abundant and good seed. * * * Cut the crop developed on all the plants in order to let the fall growth start early.

(6) **Testing the selected plants as clonal varieties.**—In order to make a further test of the 14 or 15 plants that will have been selected in accordance with the preceding paragraphs, between the 5th and the 20th of September choose another uniform plot of fairly good soil and prepare for planting an area slightly over 60 feet square. This plot should be located at some distance from any other timothy, preferably at least 200 to 300 feet. When a good season for planting comes, following a rain, dig up each selected plant in turn and separate the bulbs or slips (fig. 4), and use these in planting a row from each of the plants selected and marked. As before, place the rows 4 feet apart and the plants 2 feet apart in the rows. Transplant about 30 slips from each of the selected plants, so that there will be a single row about 60 feet long from each. The transplanting is very easily and quickly done. This plot may be designated as the "clonal test plot." If one desires to see what differences exist in timothy, a few low-yielding plants should be chosen also and planted by slips in the clonal test plot.

As soon as this clonal test plat is planted from the selected plants, the seedling test plat may be plowed up and used for other purposes.

(7) **Cultivation of clonal test plat.**—The clonal test plat should be cultivated and hoed sufficiently to keep the weeds down and to allow the full development of the plants.

(8) **Selecting the best clonal rows.**—As in the seedling test plat, the plants in the clonal test plat can not be satisfactorily judged until the second season after planting, and all that is required previous to this time is the cultivation and harvesting of the plants the first season before the seed falls. When the

plants are well headed the second season and are about to begin blooming the final examination can be made. Now go over each row carefully and examine it with reference to yield and desirability of type and select the superior row or rows. It will be best to retain at least two or three of the best rows, or more if there is but little difference in them. Good early-maturing and good late-maturing rows should be retained if both are present in the test plat.

When this selection of the best rows has been made, cut the crop on the discarded rows immediately, so that the pollen from these discarded rows will not contaminate by cross-fertilization the seed developing on the selected rows. At any convenient period these discarded rows may be dug up or plowed out, as they will be needed no longer.

(9) **Propagating from the select rows.**—The rows selected from the clonal test plat should represent almost certainly superior types, and all the seed on these rows should be allowed to ripen, when each row should be cut and thrashed separately and seed retained to plant multiplication plats, as described in the next paragraph. By a little cultivation the selected rows in the clonal test plat may be retained for at least five or six years, and probably longer, as a



FIG. 4.—Slip from timothy plant such as is used in clonal propagation.

source of supply of seed of a superior kind. In order to utilize the land around them where the discarded rows were cut out, some vegetables could be planted each year, and manure applied for the vegetables would benefit the timothy rows. As the rows of select types begin to run out or become impure by volunteer timothy plants around them or by other grasses growing in the clumps, other and more extended clonal rows could be planted from them.

(10) **The multiplication plat.**—The seed taken from the select rows of the clonal test plat should be sown in the early fall, some time before the 15th of

September, in broadcast plats as large as the amount of seed obtained will permit. The land on which the seed is to be sown should be lightly manured, plowed, very thoroughly harrowed, and pulverized. Good preparation for timothy pays as well as does good preparation for alfalfa. Sow these plats as timothy is ordinarily sown, at the rate of about 16 pounds of seed per acre. There should be enough seed from each row to plant about one-eighth of an acre. If the seed from each select clonal row is sown in separate plats adjoining one another, the superiority of one type over the others for field conditions may be judged and finally all but the best types eliminated. The seed from these broadcast multiplication plats can be utilized the next year to plant a fairly large field, which, in turn, if desired, may be harvested for seed to plant still larger areas. The various multiplication plats may be grown for several



FIG. 5.—Rows of timothy, showing average growth of selected variety on right and of ordinary commercial stock on left.

years before they become too weedy to utilize, and the time may be extended, if desired, by surface dressing with manure and by pulling such weeds as come up in the plats.

(11) *Continuation of the selection.*—If the farmer has in mind the continuous improvement of his seed with the view of ultimately selling seed regularly as improved seed (which policy is certainly to be commended), a number of seedlings should be grown in flats or boxes, as described in paragraph 2, from seeds of each of the selected rows in the clonal test plat. It will be remembered that each of these rows represents a single selected individual that has been propagated by slips, and by growing seed from these rows we are merely growing so many seedlings from the original selected plants. The number of seedlings

to be grown from each row should depend on the time that the grower has to give to the work and on the emphasis that he desires to place on his breeding. Here, as in all other breeding work, the larger the number of individuals used, the better. The writer would advise that not less than 300 to 500 plants be grown from seed of each of the select rows. These seedlings should be cared for as in the case of the first plants grown, and in early September they should be planted in a seedling test plat, following the methods outlined in paragraph 3.

When these plants reach the second crop year they should be examined and a few of the best individuals selected as in the case above, paragraph 5. These selected individuals should be dug up at the proper time and clonal test plats planted, as described in paragraph 6. From these clonal test plats the best rows should be selected, as in paragraph 8, and broadcast field test plats grown,



FIG. 6.—Sections of plats, showing improved variety on right and variety grown from good commercial seed on left.

and the seed multiplied as in the case of the first selections (pars. 9 and 10) until sufficient seed for growing large areas has been obtained.

A careful study of the method of breeding timothy outlined above, considering the length of life of the plant, will reveal that the extra trouble and work required are much less and really simpler than are required by the methods of corn selection advocated for farmers, which are being extensively used in some States. This method is the direct outgrowth of the experiments that have been conducted at Cornell, and has thus been thoroughly tested in practically every feature.

In making such selections as are outlined, it would be well, so far as possible, always to do what one can to get at least one early and one late maturing type in order that the harvest may be better controlled.

The varieties of commercial value produced in the course of the experiments at the Cornell station are being propagated as rapidly as possible in order to obtain seed for distribution to farmers in the State.

TIME TO CUT TIMOTHY.

It is pointed out that while the value of the hay crop may no doubt be greatly increased by the use of improved varieties, a great deal also depends upon the time when the hay is cut. In the Eastern and New England States, the farmers usually aim to cut their hay soon after the plants are in bloom, but a considerable part of the crop is cut at a much later period. In the Central or Corn Belt States, the cutting is usually done at a later period.

In experiments made by H. J. Waters, of the Kansas station, it was found that—

The largest yield per acre of digestible nutrient materials is obtained by cutting timothy when in full bloom and that the largest yield per acre of field-cured hay, as well as of actual dry matter, is obtained from cuttings made when the seeds were just formed, an early "milk" stage immediately after the bloom had all fallen. In each of these stages a larger yield per acre was obtained, from both the standpoint of gross weight of material and that of actual nutrients, than was obtained from earlier or later cuttings; and, while apparently not quite so palatable as when cut at a still earlier period, it would seem in general that we may conclude that the proper time to cut timothy is between the time of full bloom and the period when the blooming has just passed and the seeds are in an early stage of development.

HARDY ALFALFA.¹

In a recent bulletin of the Colorado station P. K. Blinn gives some very important practical results of several years' study of alfalfa. He states that—

In recent years the Colorado Experiment Station has been receiving numerous complaints that alfalfa is not producing what it did in former years. These complaints are made in regard to both hay and seed production. Investigation seems to verify the truth of the claims. There are many local and specific causes for some of the complaints, such as the injuries caused by grasshoppers, over-pasturing, or injudicious irrigation. There is additional cause for a general complaint in regard to alfalfa production due to a lack of vigor and vitality in the strains commonly grown. These common types we might class as the southern or Spanish varieties. Originally the alfalfa that was planted in California and the other Western States came from South America, and was in turn introduced into that country by the Spaniards during their early conquests. Most of our ordinary alfalfa can be traced to this origin.

The Colorado Experiment Station has conducted alfalfa improvement experiments since 1904. One of the results of these experiments has been to show the lack of hardiness in the southern alfalfa types. Attention was called to the contrast in seed yields and the great difference in types of plants found

¹ Compiled from Colorado Sta. Bul. 181.

in the same fields. From certain choice individual plants found at different points in the Arkansas Valley in southeastern Colorado, seed was selected and saved for the beginning of an experiment in systematic seed breeding. The most promising of these selections were sown in a nursery plot April 15, 1905. In this plot was also sown some ordinary commercial seed secured from a dealer in Rockyford, Colo., and some imported Turkestan alfalfa from Germany, furnished by Prof. W. H. Olin. * * *

So marked were the contrasts in this test in favor of the imported seed, that it was evident that a wider test of varieties should be made, in order to find the best stock to be used as a basis for alfalfa seed breeding.

During the season of 1906 the most promising plants * * * of Turkestan alfalfa were selected and saved for seed. * * * The seed of each of



FIG. 7.—Crowns of hardy (on the left) and nonhardy (on the right) types of four-year old alfalfa from the same nursery and grown under the same conditions.

these choice plants was saved separately. These with about 50 other varieties or strains received from Mr. J. M. Westgate of the United States Bureau of Plant Industry, furnished the seed for a second alfalfa nursery test. * * *

The geographical distribution of the seed that was sown in this nursery was as follows: Four from Arabia, 4 from Africa, 4 from South America, 4 from Spain and Mexico, 8 from the western parts of the United States, 8 from the Northern States and northern Europe, and 32 plants of Turkestan alfalfa from different sources. * * *

While the nursery was given uniform cultural care, there were marked contrasts in many traits, such as production of seed, leafiness of the plant, coarseness of the stems, degree of resistance to late spring frost, and some other points of practical utility.

The factor of overcrowding of the plants in the nursery had been eliminated by thinning the plants to single specimens. Yet after the winter of 1907-8 over one-half of the plants in all the plats seeded with Arabian and North African seed were dead, apparently from winterkilling, while the plats seeded with seed from Spain, Mexico, and South America had many dead plants and a good many partially killed crowns. The same was true in the native American plats. The plants were often found with just a few stems with life enough to start growth in the spring. But in the Turkestan plats and the plats sown with the northern strains of seed there seemed to be no loss whatever from winterkilling.

During the season of 1908 the nursery was allowed to produce seed, the plants being screened. The seed was saved for future work. Irrigation was withheld to induce better seed production. The dry condition seemed to increase the frost injuries the following winter, for a still greater loss of plants occurred in the same plats where the winterkilling first began. The northern strains were still free from any injury, while the plats from the Arabian and African seed were practically all dead. The loss of plants by winterkilling has continued to occur to some extent in the nonhardy plats for the past four winters. * * *

During the past four years careful examination has been made of many hundred plants to determine the cause of the loss of plants in one plat and not in another. Several seedlings have been made and plowed up in order to study the relative difference, if any, between the crowns where winterkilling occurred and where it did not.

It has been observed that a marked difference exists between the type of the crown or the stooling habits of the hardy and nonhardy strains. Figure 7 illustrates this contrast in the crowns of two 4-year-old plants taken from the nursery, each representing a typical crown of the two types of plants. The distinction between these types may be better understood with younger plants. Figure 8 shows two very representative plants of these two types, only four months' growth from seed, both grown under the same field conditions. The nonhardy type is shown on the left. It has a compacted upright growing crown with comparatively few buds or shoots below the surface of the soil. The buds are thus exposed to freezing, thawing, and drying out, which eventually weakens and kills alfalfa in the arid regions.

The hardy type is shown on the right. This is characterized by a more spreading crown with numerous buds and shoots springing from the crown below the surface of the soil. These underground shoots in some of the best plants of this type have been found several inches below the surface of the soil. The bud area in this type of plant is thus protected by the soil from drying or freezing. A fine specimen of this type of plant is shown in figure 9. The soil in this case was removed 3 inches deep to expose all the underground shoots, some of which were over 8 inches in length. This plant was from a nursery row of the *Grinum* alfalfa, only six months' growth from seed. The seed that produced this plant came from a field, in northern Minnesota, over 40 years of age. The hudding area of such a plant is enormous. It will stand the loss of many buds without apparent injury and the soil protection will insure it against the usual winter cold.

There is also a tendency for the underground shoots to take root at some distance from the old center crown. This may be seen by observing the numerous small roots that are extending beneath the large crown in figure 7. In old stools of alfalfa of this type the original plant has been found in some cases to be dead. But it was surrounded by a ring of healthy secondary crowns

formed by the underground shoots that have taken root and formed independent plants. Thus the hardy type will maintain a permanent stand of plants, while the nonhardy type, which has the upright compacted crown with the buds exposed, has scarcely any tendency to take root from the crown. This will result in serious injury, in time weakening and eventually destroying the plant. Thus the stand of plants in the nonhardy type is bound to become thin.

The relation of the stooling habits in alfalfa to the vigor and vitality has been repeatedly shown in the nursery and field tests of the past seven years. * * *

There seems to be a grading of the types to different degrees of hardness. This can be seen in the irregular size and types shown in the figures * * *

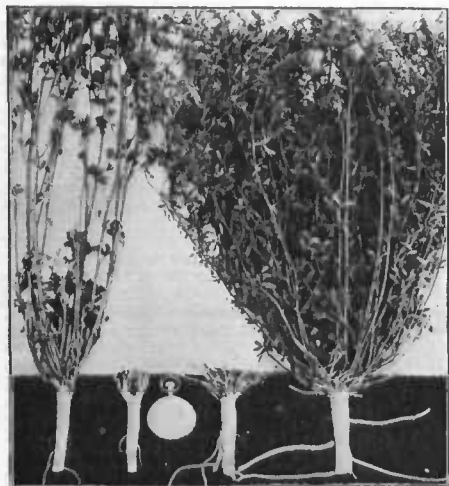


FIG. 8.—Four-months-old alfalfa seedlings, showing contrast in stooling habits of hardy (on the right) and nonhardy (on the left) plants.

and in almost any field of alfalfa. This is evidently one of the reasons for the gradual loss of plants. The least hardy types are the first to be killed, the others following gradually as the conditions become more severe. There are evidently other factors that go to make up resistance to cold besides the stooling habit. There is a difference in the effects of frost on the green leaves and stems of the plants above ground. The dark-colored foliage is apparently more resistant than the light-green color. * * *

Turkestan alfalfa, because of its stooling habits, has been mentioned in this bulletin as one of the hardy types. So far it seems to be a desirable variety,

although there is a wide variation in the different strains. There are also several objectionable features to the Turkestan alfalfa, namely, a tendency to produce a poor yield of seed and a habit of very early starting in the spring, with a correspondingly early check in growth in the fall. Thus, the first crop is made light or injured by late spring frosts and the last crop is cut short by the plants beginning to become dormant. Hence, for Colorado conditions Turkestan alfalfa has not proved to be the most desirable.

The results of the nursery tests seem to emphasize the fact that there is more significance in the type of the plant from which the seed comes than in the variety name or the locality from which the seed may be derived.

The alfalfa seed commonly sold on the markets has had no special breeding outside the natural selection from winter elimination.

In Minnesota and in North and South Dakota, where the winter conditions are far more severe than in Colorado, the tests of alfalfa varieties for cold resistance have been very interesting. In several large variety tests the same results have been secured, namely, the Grimm, Baltic, and Turkestan varieties of alfalfa have proven to be the most hardy of a large list of alfalfas from different parts of the world. These results tally almost exactly with the results of similar tests in Colorado. All of these three strains have a distinct type of crown as compared to the type of crown found in the nonhardy varieties. The fact is the hardy strains of alfalfa have spreading crowns with underground root stocks and shoots

with buds which are protected by soil from winter freezing. The nonhardy strains of alfalfa have more upright stooling crowns with the bud areas very near the surface, exposed to winter freezing, thawing, and drying out. Hence, there is a decided relation between the type of the crown and its tendency to winterkill.

The stooling traits of the hardy strains are shown in the early seedling stage. This is illustrated in figures 10 and 11. Figure 10 shows some seedlings of Grimm alfalfa only six weeks from seed. Figure 11 shows some ordinary Spanish alfalfa the same age. Both



FIG. 9.—A good specimen of the hardy type of alfalfa, showing extensive system of underground shoots and stooling habit.

lots were taken at the same time and under the same conditions in the field. The heavy stooling habit of the Grimm alfalfa is very evident. The significant value of this trait can hardly be overestimated. It not only affords immunity from winter losses, but the protected underground buds are less liable to injuries from overpasturing or attacks from grasshoppers. The spreading crown seems to be associated with a very much branched surface-root system, in addition to the deep tap root. This growth habit makes surface moisture easily available. Hence, it is not surprising that the Grimm and Baltic alfalfa should have proven to be the best type for dry conditions. This is confirmed by the dry-land tests.

The Grimm and Baltic strains of alfalfa have revealed the most promising traits in the Colorado tests, but the Baltic seems to be in the lead in seed production and slightly in the lead in hay yields. Apparently there is little difference except in seed yield, yet there are contrasts in the relative merits of different selections which are evidently transmitted. Hence, the strains of alfalfa can be made more uniform through seed selection. * * *

The conclusion is that a hardy, desirable hay-producing alfalfa, with good seed-yielding tendencies, is within easy reach by means of systematic seed breeding.

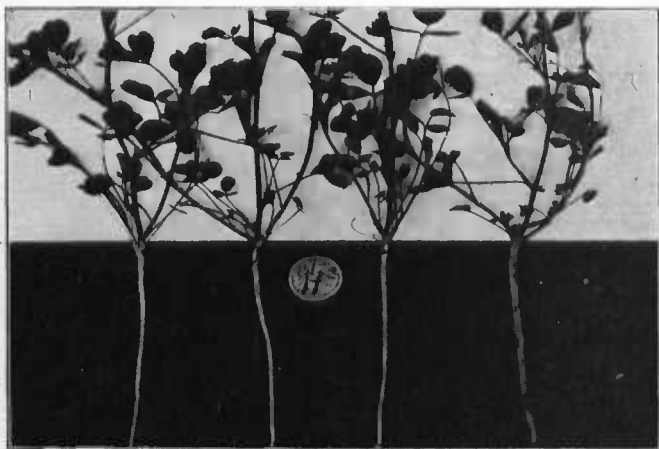


FIG. 10.—Seedlings of Grimm alfalfa, six weeks from seed, showing early stoloniferous habit.

HARVESTING, THRASHING, AND STORING SOY BEANS.¹

In a recent bulletin of the Kentucky station, George Roberts and E. J. Kinney give the following directions for harvesting, thrashing, and storing soy beans:

HARVESTING.

When the soy bean approaches maturity the leaves begin to turn yellow and drop, and before all the pods are ripe the leaves are all off. When grown for seed this is the proper time to cut, or when about three-fourths of the pods are ripe. If cut earlier it is difficult to cure them properly, and if not cut until very ripe the beans are liable to shell out badly, and the dry woody stems are hard to cut. If taken at this stage the beans may be cut at any time of the

¹ Compiled from Kentucky Sta. Bul. 161.

day with little loss by shattering, but if allowed to become very ripe they should be cut in the morning or evening.

For hay the beans should be cut when the pods are a little less than half filled. They contain as much nutriment at this time as it is possible to get and not have hard woody stems. * * *

Cutting and curing for hay.—For hay the beans are cut with the mower and as soon as wilted raked into small windrows. They are allowed to dry here for a short time, and should then be put into small shocks and allowed to stand until well cured. Experience is necessary in curling soy-bean hay, but those who have made cowpea hay will find less trouble in curing that of soy beans. A correspondent writes in regard to curling cowpea hay that he sets posts about 1 foot into the ground, nails crosspieces near the bottom, and shocks the

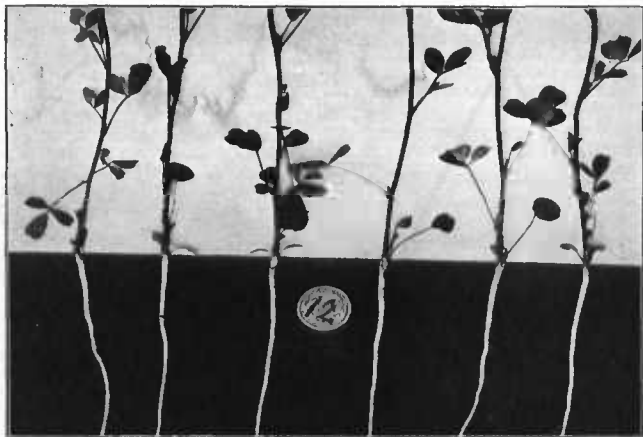


FIG. 11.—Seedlings of ordinary Spanish alfalfa, six weeks from seed, showing upright growth and less tendency to stool or form a crown.

hay over the posts as soon as cut. The forkfuls of pea vines are slipped over the post, which is sharpened, and a good-sized shock made. No further attention is given until the hay is cured. He claims that hay cured in this way is of extra fine quality, but does not say how much time it takes to handle the hay in this manner. It would probably not prove practical on a large scale, but is worth trying with a small crop.

Another contrivance often used in curling soy-bean or cowpea hay is illustrated in figure 12. The hay is allowed to wilt and is then raked into windrows and piled over these frames. Being held up from the ground and having an air space in the center of the shock, the hay, of course, cures quite rapidly. This apparatus appears to the writers to be more practical than the one described above.

Neither soy bean nor cowpea hay keeps well in a stack unless given a good covering of timothy or other grass, because the coarseness of the stems allows the water to penetrate so readily. The stack should also be made on brush, rails, or boards to keep the hay from becoming damp and moldy on the bottom. * * *

Cutting for seed.—The mower, self-rake, and binder have all been used at the station for cutting soy beans, and all have proved more or less satisfactory. If cut with the mower, especially when very ripe, running over them with the machine and the tramping by the team will shell some. It is also necessary to rake them into windrows, which also causes some loss. The old self-rake reaper is very satisfactory, as the beans are placed in bunches out of the way of the machine and the team. These bunches can be turned and allowed to dry, and then two or three rows of them put together, so they may be loaded on the wagon conveniently. Unfortunately few of these old reapers are in use now.

The binder will probably prove the best machine to harvest soy beans with if they are not allowed to become too ripe and if the plants are not too short. The bound bundles should be shocked, 8 or 10 to a shock, and allowed to remain until thoroughly dry. They are easily handled, and there is less waste and less injury by rain when cut this way than in any other.

After they are thoroughly dry the beans should be stacked, using brush or boards to keep them up off the damp earth, and the stack should be well topped off with hay. They may be thrashed after about a month or six weeks or left as long as desired. If rains occur while the beans are in the field little or no damage will result. If



FIG. 12.—Device for curing soy-bean hay in shock.

In piles, they should be turned after a rain to prevent their remaining damp too long a time.

THRASHING.

The ordinary grain separator can be adjusted to successfully thrash soy beans, but as equipped for small-grain thrashing a large percentage of the beans will be cracked or split. This does not injure them for feeding purposes, but ruins them for seed or for sale.

The experiment station owns a small separator, which is used to thrash the grain crops grown on the farm, and considerable time has been spent in studying the necessary adjustments for thrashing soy beans. In general, the machine is like all separators, and the same adjustments will apply to all machines.

The chief cause of split beans is the high speed of the cylinder. The speed is reduced one-half and the speed of the fans and other parts is maintained by doubling the size of both cylinder pulleys. A special set of thin concaves is used. The ordinary thick concaves leave so little space between cylinder teeth and concaves that some of the beans will be cracked in passing. Only as many rows of concaves are used as are necessary to insure clean thrashing. This

depends, of course, upon the condition of the beans. If very dry, as they should always be when thrashed, a very few rows may be required and the rest of the space may be filled with blanks. The iron grating behind the cylinder should be replaced by a sheet-iron pan, for the beans are hurled against the grating with such force that many may be split. Another adjustment found necessary was the conveyor extension. In thrashing soy beans many hulls are detached from the stalks and stems and fall through the straw conveyor to the conveyor sleeves. Being heavy, the blast is not strong enough to drive them out, and they fall through the conveyor extension into the tailings screw, choking this and the return elevator. At first a solid conveyor extension was substituted, but the heavy load of hulls carried by the conveyor sleeve also carried some thrashed beans along, and these were carried out to the straw carrier. To avoid this a conveyor extension was made of parallel rods about one-half inch apart, which allows the beans to drop through into the tailings screw but prevents many of the hulls going through. All beans must be thrashed at first passage. The fan blast is not strong enough to separate filled pods from unfilled ones, nor can a conveyor extension be made to accomplish this. The only function of the latter is to allow the thrashed beans that have not gone through the sleeves to drop into the tailings screw and be carried back to the cylinder. If an extension made as described above is used, the tailings will be very small in quantity.

All the necessary adjustments mentioned above except the conveyor extension can be secured of separator manufacturers at a relatively small cost. It will pay a farmer growing a considerable acreage of soy beans to buy the necessary equipment if the owner of the separator does not feel justified in doing so. If the size of the crop justifies, a special bean huller may be purchased in partnership by several men and an engine hired to run it. Such a machine can be bought for about \$300. There is no question that when the soy bean crop receives the recognition it deserves, every owner of a thrasher will equip himself to handle the crop. When only an acre or two is grown, the beans may be thrashed out with flails. This is not such a slow process as would be imagined, as 10 to 15 bushels per day, when the air is thoroughly dry, can be thrashed by a good man.

Soy beans can not be satisfactorily thrashed unless thoroughly dry. They should stand in the stack for a month or more and then a bright dry day be chosen for the work. One year an attempt was made on the station farm to thrash damp beans. Later the straw was rethrashed, yielding 16½ bushels more from 8 acres.

CARE OF THE SEED.

Some care is necessary in storing soy bean seed to prevent heating, which is especially liable to happen if the seed is hulked together in large quantities in a bin or other poorly ventilated receptacle, and almost certain to happen if the beans are not perfectly dry when thrashed. All seed stored in this manner should be examined occasionally for a month or so to detect any tendency to heat. If it should show such signs, it must be removed at once and spread out until perfectly dry. Heating will ruin the beans for seed purposes, as the power of germination is destroyed.

At the station we have never had any difficulty in keeping the seed and have never lost any by heating. As stated, the beans are allowed to remain in the stack for a month to six weeks, when they will be very dry. When thrashed the seed is put into burlap sacks and ricked up in a well-ventilated place. In ricking the sacks of seed two are placed beside each other and the next two laid across these in the opposite direction. This gives more space between the

sacks and better ventilation. They are left in the sacks until used. Soy beans are seldom attacked by weevil, but when a seed house becomes badly infested with these troublesome little beetles they will infest almost any grain, including soy beans. They may be destroyed by carbon bisulphid.

All soy beans should be tested for germination before planting, as they lose their germinating power through age or improper handling.

SOY BEANS FOR SILAGE.¹

In a previous Farmers' Bulletin² brief reference is made to the successful use of soy beans for silage, usually in combination with corn. In a recent bulletin of the New York Cornell station E. R. Minns deals with the subject more fully, showing how soy beans have been successfully grown by practical farmers as a supplement to corn in silage making. The advantage of such a combination lies in the fact that soy beans are nitrogen gatherers, and hence are richer in nitrogenous compounds than corn. Mixed corn and soy bean silage is therefore a more evenly balanced feed than corn silage alone.

At the Massachusetts Hatch station, a comparison of the amounts of protein, fat, and carbohydrates produced on an acre each of soy beans and flint corn cut for green fodder, showed that the soy bean acre produced nearly 34 per cent more of protein than did the acre of corn; while the acre of corn produced over 84 per cent more of carbohydrates and fat than did the acre of soy beans. Ensilage made from corn alone is known to be a wide ration and needs to be supplemented with foods richer than itself in protein in order to balance the ration. The Massachusetts test indicates how this may be done where both the corn and the soy beans can be grown to a reasonable degree of maturity and combined when filling the silo. It is not to be inferred that a mixture of the two crops will make it unnecessary or unprofitable to feed grain in the ration; but in practice it has been found possible to reduce the amount of grain fed to dairy cows and maintain the milk flow if a portion of the ensilage consists of soy bean fodder. The digestibility of soy beans compares favorably with that of alfalfa and clover. Ensilage made from corn and soy beans has been found more digestible than that made from dent corn alone.

The corn and soy beans may be grown for silage separately or in mixture. Many farmers follow and advocate the latter practice, but the Cornell station experiments cast doubt upon its advisability in view of the fact that the beans are apt to be crowded out in the competition with corn when the two are grown together. It would appear that the harvesting and maintaining of the desired proportions of bean and corn could be more certainly accomplished by growing the two separately.

Soy beans grown for silage should be harvested when the pods are mostly filled and the leaves have not begun to fall off. They may be harvested with a side-delivery reaper or with a twine binder.

Soy beans cut for silage must be hauled from the field and mixed with corn fodder at the cutting box in order to have the mixture of corn and soy beans

¹ Compiled from New York Cornell Sta. Bul. 310.

² U. S. Dept. Agr., Farmers' Bul. 372.

evenly distributed in the silo. In this way any proportion of beans to corn may be made at will. It is not wise to use more than one load of beans to two of corn, and one to four will be found to enrich the silage noticeably. Soy beans alone, because of their high protein content, tend to make a strong-smelling, objectionable silage. Their dilution with corn fodder in the silo reduces the danger of strong odors and makes the silage more nutritious and not less palatable than that from corn only. The yield of soy-bean fodder can not be so heavy as the yield of corn from the same ground. On a fixed area, therefore, the total yield of both corn and soy-bean fodders will be less than if all corn were grown. In order to follow the above practice the grower must either cultivate more acres or else be content with a smaller quantity of fodder.

FAT IN MILK OF COWS AT TIME OF CALVING.¹

The usual objections raised against seven-day tests of dairy cows are that they do not give a fair estimate of the yearly production of the cow, and that by preparing cows for seven-day tests by long dry periods before calving and selecting breeding animals on the basis of seven-day records there is a tendency to develop individuals that will produce heavier for a short time but not persistently. Recent investigations by Prof. Eckles, of the Missouri station, show conclusively that the percentage of fat in seven-day tests of cows may be entirely abnormal. The determining factor in this variation is the condition of the animal as measured by the amount of fat stored in the body at the beginning of the milking period.

One of the cows used in the tests reported by Prof. Eckles calved when she was in a fat condition. An official seven-day test was begun on the tenth day after parturition, and the per cent of fat by milking during the seven days ranged from 4.2 to 9.3, with an average for the week of 5.1. Approximately one year later the cow calved again, but this time she was much thinner in flesh. In seven days, beginning the same length of time after calving as did the first seven days' record, the average per cent of fat in the milk was 3.63. This same cow was entered in the Advanced Registry with an official test of 4.09 per cent fat, although her average for the year was 2.76 per cent. Similar results were obtained with a number of other cows tested for purposes of these investigations.

This subject is one of great practical importance in several ways, as Prof. Eckles states:

First of all, it has a bearing upon the economical production of milk by emphasizing the importance of having cows in good flesh at the time of calving. * * * The data that have been given indicate that when the cow has a considerable amount of fat stored up in the body at the beginning of the milking period the milk will contain a higher fat percentage for a certain period than will be the case if the same animal is thin in flesh at the beginning of the milking period. * * * One of the necessary conditions to bring about this

¹Compiled from Missouri Sta. Bul. 100.

abnormal percentage of fat in the beginning of the lactation period seems to be underfeeding. * * * As is well known to all practical herdsmen, it is impossible to feed a cow that is in good flesh and is at the same time an animal with strong dairy characteristics, a sufficient amount of feed during the first month after calving to maintain the weight of the animal. There is certain to be some decline in weight, and for this reason where a cow is more moderately fat at the beginning of the lactation period there is almost certain to be some effect upon the richness of milk for a time regardless of whether any special attempt is made to bring this about or not. * * * The relation of the data presented to the methods of carrying on official tests of dairy cattle is evident, and it is along this line possibly that the subject is of the greatest immediate interest. It is evident from the data given that it is possible, by taking a short period at the beginning of the lactation period, to secure a percentage of fat which is entirely abnormal for that animal, and for this reason such tests have very little practical significance and are apt to be misleading to a person who is not familiar with the means by which it is possible to secure such abnormal results.

CLEAN CREAM.¹

In a previous article² attention was called to the large losses to farmers as a result of the production of low-grade or unclean cream. A recent publication of the Kansas station gives the following concise rules for producing clean cream:

- (1) In favorable weather keep the cows in the pasture as much as possible, thus preventing an accumulation of manure in the stable or corral.
- (2) Remove the dirt from the cows' udders and flanks before milking and wipe the udders with a damp cloth.
- (3) Do not feed hay or dusty feed just before milking.
- (4) To clean pails and cans, first wash them clean with warm water and a mineral washing powder, then rinse them well, scald them, and allow them to drain.
- (5) Skim about a 35 per cent cream.
- (6) Take the separator apart and wash it thoroughly after each separation.
- (7) Remove the cream to a milk house or cool place where the air is pure and where the can may be placed in a trough or barrel of cold water fresh from the well.
- (8) Do not mix warm cream with cold cream, nor keep cream in cellars or caves.
- (9) See that all cans and tinware coming in contact with cream are perfectly sweet and clean, especially in the seams and crevices.
- (10) Deliver the cream in the morning during hot weather. Make at least three deliveries a week in summer and two in the winter.
- (11) At all times protect the can containing cream against heat, cold, and dust by covering the can completely with a clean canvas.

¹ Compiled from Kansas Sta. Circ. 24.

² U. S. Dept. Agr., Farmers' Bul. 504, p. 17.